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ScienceDirect
Palaeoworld xxx (2018) xxx–xxx
Palaeoworld
www.elsevier.com/locate/palwor

# Main biotic and climatic events in Early Permian of the Western Urals, Russia, as exemplified by the shallow-water biota of the early Kungurian lagoons

Serge V. Naugolnykh [a,b,*]

[a] *Geological Institute of Russian Academy of Sciences, Moscow, Russia*
[b] *Kazan Federal University, Kazan, Russia*

Received 10 June 2018; received in revised form 9 September 2018; accepted 17 October 2018

**Abstract**

The paper deals with the Early Permian (mostly early Kungurian) biotas of the Cis-Urals (Perm region, Russia). Taxonomic composition of the early Kungurian biota of the stratotype area (close vicinity of the City of Kungur) includes algae *Algites philippoviensis* Naugolnykh, *A. shurtanensis* Naugolnykh, tracheophytes (higher plants), i.e., equisetophytes *Paracalamites* spp., conifers *Shaidurodendron columnaris* Naugolnykh, *Walchia appressa* Zalessky, vojnovskyaleans *Rufloria derzavinii* (Neuburg) S. Meyen etc.; invertebrates: coelenterates of uncertain affinity, bivalves *Permophorus costatus* (Brown), *Permophorus* sp., *Netschajewia* sp. cf. *N. tschernyshowi* (Licharew), gastropods *Goniasma angulata* (Stuckenberg), terebratulid brachiopods *Dielasma* sp. cf. *D. moelleri* Tschernyschew, arthropods (limulids *Paleolimulus kunguricus* Naugolnykh); vertebrates: chondrichthyan and actinistian fishes.

Paleogeographically, the studied area belonged to the near-shore zone of a large lagoon basin disposed along the western-southern part of the Paleo-Urals during the Kungurian time. The main events in evolution of this basin reflect the final phases of the Artinskian sea basin with normal salinity, the transition to an early Kungurian (Philippovian) lagoon, then the appearance of intercalations of evaporate conditions and episodic incursion of marine faunas, and finally a gradual transition to semi-terrestrial environments with the cyanophyte communities in early Ufimian (Solikamskian, early Roadian) time. Climatic conditions in this area changed from semi-humid to semi-arid. A new genus and species of algae *Dichothallus divaricatus* Naugolnykh n. gen. n. sp. is described on the basis of material originated from the stratotype of the Philippovian Horizon of the Kungurian stage, Lower Permian.


*Keywords:* Permian; palaeontology; stratigraphy; stratotype; algae; new taxa

## 1. Introduction

The paper deals with the general characteristics of the shallow-water biota of Kungurian stage, Lower Permian of the Urals, Russia. The main scope of the research is concentrated on the main biotic events in Early Permian (mostly, Kungurian) of the Urals, and their interpretation in terms of interregional stratigraphy.

The research history of the studied area is very long and complicated. The main mile-stones of this history are discussed in many bibliographical sources, such as: (Chuvashov et al., 1990; Chuvashov and Chernykh, 2000; Naugolnykh, 2007b; Ponomareva et al., 2017). The general stratigraphic and palaeontologic framework for the Kungur region (i.e., historical stratotype area for the Kungurian stage) was created as an important result of these studies.

In the present research several representative outcrops were studied as a basis for the detailed study (Figs. 1, 2). Most of them represent the Kungurian stage in its historical stratotype sections nearby the City of Kungur, Perm region. Others are disposed in close vicinity of the City of Krasnoufimsk, Sverdlovsk region,

* Corresponding author at: Geological Institute of Russian Academy of Sciences, Moscow, Russia.
*E-mail address:* naugolnykh@list.ru

https://doi.org/10.1016/j.palwor.2018.10.002
1871-174X/